Optimizing Query Response with XML User Profile in Mobile Clinical Systems

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Background

Improvements of modern mobile technology, have created a need for a mobile clinical environment. In the field of mobile clinical systems, getting information on time is as important as mission critical aspects. However, web access time with the mobile device is still not feasible clinically. Therefore, the optimisation of query response becomes an important issue.

We have developed a query optimising method using a user profile. We analysed user (clinician) specific queries in the medical field. Most of the data retrieval in the medical field is focused on the clinical test results[1], and the patient's demographic information. Sometimes the information requested in the medical field places a heavy load on the database, since such information may require full database scanning and much joining of tables in the databases. In such cases, constructing profile data and employing it for data retrieval would help to improve the response time. The use of a predefined profile avoids the multiple joining process, and shortens the total response time. The object of our research is to improve query response by creating user profiles and using this profile information for patient data retrieval.

Methods

We implemented this technology to a prototype mobile clinical system, MobileMed™. In this system, all the clinical records from various institutions are gathered in a central relational database. The system searches the central database and return the result data in XML format. The retrieved XML data is then transformed into html documents in the XSLT processor and presented on a web site in a format suitable for the accessing mobile device. This web-based interface makes it possible to access using any type of mobile device.

For further speeding-up the searching process, we created a user profile in a profile manager. The profile consists of unique patient identifiers, whose clinical laboratory test results are frequently requested, and some patients demographic information. As for the difficulties updating and the storage space limitations, the data added to the primary key should be consistent and frequently used information related to that patient, like the patient's name, sex or birthday. Adding additional data and using it as a result set reduces the database query process. Therefore, we expected this process would outperform patient profiles composed of primary keys for query optimising on a large dataset.

In the profile manager, the contents of a profile are extracted using the DOM. The primary keys are used as search index keys for database SQL query. Additional information is regarded as result data, it is transformed to html format and combined with the results retrieved from the database.

The experiments were performed to determine if the proposed method really optimises query response, and to decide upon the contents that should be contained in the profile. We measured the retrieval time of our predefined profile set (*case1*) and two comparative sets incorporating 10-fold increases in patient numbers. One of these sets processed pure SQL queries without the aid of a profile (*case2*), and the other one used a profile consisting of only primary keys (*case3*).

We issued a query requesting a patient's clinical test results over a period of 15 days on the MobileMed™ system. We also increased the record size of the patient visit information table and of the administration data table, which are joined with the user information table to retrieve patient information. By increasing the database size n times versus the original at each n^{th} experiment, we obtained the pure retrieval processing time for the 3 cases, as a measure of performance. In each experiment, we performed the identical test 12 times and calculated the mean processing time (after excluding the highest and lowest values), to more accurately determine the processing time.

Results

We compared the experimental results of the above 3 cases. *Case2* showed the best performance with the smallest test data set. *Case2* was 15.22% faster than c*ase1* and had 26.0% better performance than c*ase3*. However in the 4^{th} experiment, involving more than 18222 patient visits and administrative records, retrieving patient data by using the user profile method showed was found to have an explicitly better performance than SQL queries. Moreover, the user profile method outperformed SQL more so as the patient number was increased. In the 10^{th} experiment, *case3* outperformed *case 2* by 43.04%, and *case1* outperformed *case 2* by 43.89%.

By these experiments, we found that the query optimising process using a profile for patient data retrieval was very successful. However, we could not see any explicit performance differences between cases1 and 3. Therefore, we cannot say which is represents the better constitution of a profile, i.e., one composed of just primary key indexes or one composed of primary keys and additional information. In conclusion, query optimising using the primary keys containing profile really improves total response time, regardless of the constitution of the profile.

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